MODBUS

M930 protocol description

User's manual

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1. Basic information

1.1. Introduction to Modbus

This document specifies the MODBUS communications protocol as implemented on the magnetic flowmeter M930.

This manual does not try to be a complete guide to the MODBUS protocol, but will show how to structure a message that the instruments will recognize.

For Modbus communication is used USB interface. Instruments communicate using a master-slave technique, in which only one device is the master and theslave devices supply the requested data when addressed. Typical master devices can be a host computer.

Only the master can initiate transactions (requests), and only the addressed device responds.

The Modbus request consist of:

- an address,
- a function code defining the requested action,
- data (if necessary for the requested function), and
- error check for testing the integrity of the message.

The slave's response contains:

- the slave address,
- data conform the request type, and
- error check.

If the data integrity test fails, no response is sent back.
If a request cannot be processed an exception message is returned.

1.2. Transmission format

There are two serial transmission modes for the MODBUS protocol, ASCII or RTU (Remote Transmission Unit) framing. The user has to select the desired protocol along with the serial communication parameters (baud rate, paritytype). Note that all these parameters must be the same for all instruments in the network.

1.2.1. ASCII-mode

When device communicate on a MODBUS serial line using ASCII mode, each 8–bit byte in a message is sent as two ASCII characters. This mode is used when the physical communication link or the capabilities of the device does not allow the conformance with RTU mode requirements regarding timers management.

Remark : this mode is less efficient th

an RTU since each byte needs two characters.

The format (10 bits) for each byte in ASCII mode is :

Coding System: Hexadecimal, ASCII characters 0–9, A–F. One hexadecimal character contains 4-bits of data within each ASCII character of the message

Bits per Byte: 1 start bit
7 data bits (least significant bit sent first)
1 bit for parity completion
1 stop bit

The default parity mode is Even parity.

Remark : the use of no parity requires 2 stop bits.

ASCII Message framing:

Start	Address	Function	Data	LRC	End
1 char :	2 chars	2 chars	0 up to 2x252 char(s)	2 chars	2 chars CR, LF

In ASCII mode, a message is delimited by specific characters as Start-of-frames and End-of-frames. A message must start with a ‘colon’ (:) character (ASCII 3A hex), and end with a ‘carriage return – line feed’ (CRLF) pair (ASCII 0D and 0A hex).

In ASCII mode, messages include an error–checking field that is based on a Longitudinal Redundancy Checking (LRC) calculation that is performed on the message contents, exclusive of the beginning ‘colon’ and terminating CRLF pair characters.

1.2.2. RTU-mode

When devices communicate on a MODBUS serial line using the RTU (Remote Terminal Unit) mode, each 8–bit byte in a message contains two 4–bit hexadecimal characters. The main advantage of this mode is that its greater character density allows better data throughput than ASCII mode for the same baud rate. Each message must be transmitted in a continuous stream of characters.

The format (11 bits) for each byte in RTU mode is :

Coding System: 8–bit binary

Bits per Byte: 1 start bit
8 data bits (least significant bit sent first)
1 bit for parity completion
1 stop bit

The default parity mode is even parity.

Remark : the use of no parity requires 2 stop bits.

RTU Message framing:

Start	Address	Function	Data	CRC	End
>= 3.5 char.	1 byt	1 byt	0 up to 252 byte(s)	2 bytes	>= 3.5 char.

In RTU mode, message frames are separated by a silent interval of at least 3.5 character times.

The RTU mode includes an error–checking field that is based on a Cyclical Redundancy Checking (CRC) method performed on the message contents.

2. Supported functions

2.1. Read coil status (Function 01)

Function reads the ON/OFF status of discrete inputs or discrete (bit) variables in the instrument. Query contains the starting coil address and the quantity of coils to be read.

2.2. Read input status (Function 02)

Function 1 and 2 perform the same action – see description of Function 01.

2.3. Read multiple holding registers (Function 03)

Function reads the binary contents of holding registers in the instrument. Query contains the starting registr address and the quantity of registers to be read. The maximum number of registers at each request is limited to 44 (RTU) or 22 (ASCII). Exception is double which can be read only one variable using this function.

2.4. Read input registers (Function 04)

Function 3 and 4 perform the same action – see description of Function 03.

2.5. Write single coil (Function 05)

Function writes to a single coil value ON or OFF. ON value is presented as 0xff00, OFF value is presented as 0x0000. Command contains the coil address and requested value. The normal response is an echo of the command, returned after the coil state has been changed.

2.6. Write multiple holding registers (Function 16)

Function writes new values into a sequnce of holding registers. Command contains the register starting address, number of affected registers and requested values. The normal response contains number of changed registers. In this function can be write just one variable (integer, float, double ...).

3. Commands table

Tables in this chapter contain following columns (description of variables):

1) Address
2) Name
3) Type
4) Access – Read / Write
5) RS232 command – see description of this command in the user's manual

3.1. Table 1 Bit variables (single coils)

Address	Name	Type	Access	RS232 command
0x1000	Negative flow direction	bit	R/W	FFD
0x1001	System error status	bit	R	RES
0x1002	Auxiliary volume clear	bit	R/W	CLRAV
0x1003	Total volume clear	bit	R/W	CLRVO
0x1004	Datalogger clear	bit	R/W	DCLR
0x1005	Positive and negative volume clear	bit	R/W	CLRVM
0x1006	Direct reset from Main menu	bit	R/W	FME

Bit variables data format:

```
ON  is expressed as 0xff00
OFF is expressed as 0x0000
```

3.2. Table 2 Integer variables (holding registers)

Address	Name	Type	Access	RS232 command
0x3000	Nominal diameter	integer	R/W	RDN
0x3002	Datalogger filling (bytes)	integer	R	DBT

Integer variables data format:

```
MSB                             LSB
(most sign.bit)    (least sign.bit)
---------------- ----------------
|X|X|X|X|X|X|X|X| |X|X|X|X|X|X|X|X|
---------------- ----------------
      byte 1           byte 0
```

3.3. Table 3 Long variables (holding registers)

Address	Name	Type	Access	RS232 command
0x5000	Calibration password access setting	long	R/W	FPC
0x5002	Password setting	long	W	PSW
0x5004	Basic password access setting	long	R/W	FPB
0x5006	Errors reading	long	R	IER
0x5008	Datalogger number of samples	long	R	DNR

Long variables data format:

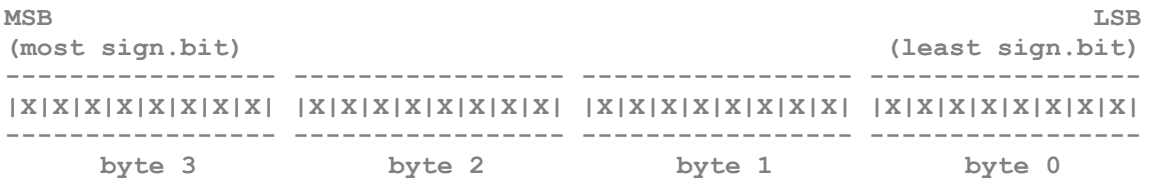
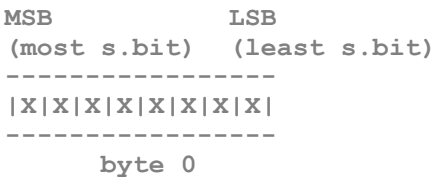


Table 5 Char variables (holding registers)

Address	Name	Type	Access	RS232 command
0x6001	Flowrate unit	char	R/W	FFS
0x6002	Volume unit	char	R/W	FVS
0x6003	Time constant	char	R/W	FTC
0x6004	Excitation frequency	char	R/W	FEC
0x6005	Datalogger step	char	R/W	DST
0x6007	Language setting	char	R/W	FLG
0x6008	Number of calibration points	char	R/W	CPN
0x6009	Contrast setting	char	R/W	FDC
0x600a	Message time setting	char	R/W	FDM
0x600b	Date format setting	char	R/W	FDF
0x600c	Actual access level	char	R/W	PAL

Char variables data format:



3.4. Table 6 Float variables (holding registers)

Address	Name	Type	Access	RS232 command
0x7000	Conversion constant for flowrate user unit	float	R/W	FFC
0x7002	Conversion constant for volume user unit	float	R/W	FVC
0x7004	Low flow cutoff	float	R/W	FLF
0x7006	Actual flowrate	float	R	RFL
0x7008	Nominal flowrate	float	R/W	RQN
0x700a	Electroni unit temperature	float	R	IT
0x700c	Nominal value of calibration point 1	float	R/W	CX1
0x700e	Calibration constant for calibration point 1	float	R/W	CY1
0x7010	Nominal value of calibration point 2	float	R/W	CX2
0x7012	Calibration constant for calibration point 2	float	R/W	CY2
0x7014	Nominal value of calibration point 3	float	R/W	CX3
0x7016	Calibration constant for calibration point 3	float	R/W	CY3
0x7018	Nominal value of calibration point 4	float	R/W	CX4
0x701a	Calibration constant for calibration point 4	float	R/W	CY4
0x701c	Battery voltage	float	R	IU1
0x701e	CPU voltage	float	R	IU2
0x7020	Internal voltage +5V	float	R	IU3
0x7022	Internal voltage +3,6V	float	R	IU4
0x7024	Internal voltage -3,6V	float	R	IU5
0x7026	Reference voltage +2,5V	float	R	IU6
0x7028	Excitation coils current	float	R	ICO
0x602A	Datalogger filling (percentage)	float	R	DPC

Float variables data format:

Where:
S: sign bit where 1 is negative and 0 is positive
E: exponent with an offset of 127
M: 24-bit mantissa (stored in 23 bits)
The mantissa is a 24-bit value whose most significant bit (MSB) is always 1 and is, therefore, not stored.

3.5. Table 7 String variables (holding registers)

Address	Name	Type	Access	RS232 command
0x8000	Device identification	string[22]	R	IDN
0x800B	Flowrate unit user text	string[6]	R/W	FFU
0x800E	Volume unit user text	string[4]	R/W	FVU

String variables data format:

```
String variables have defined length (see table above) and consists of
ASCII characters. One byte represents one character.
```

3.6. Table 8 Double variables (holding registers)

Address	Name	Type	Access	RS232 command
0x9000	Volume	double	R	RVO
0x9004	Volume positive	double	R	RVP
0x9008	Volume negative	double	R	RVN
0x900c	Volume auxiliary	double	R	RVA

Double variables data format (decimal/64 data format)

```
MSB
(most sign.bit)
---------------- ---------------- ---------------- ----------------
|S|E|E|E|E|E|E| |E|E|E|E|M|M|M|M| |M|M|M|M|M|M|M|M| |M|M|M|M|M|M|M|M|
---------------- ---------------- ---------------- ----------------
      byte 7           byte 6           byte 5           byte 4
                                                              LSB
                                                    (least sign.bit)
---------------- ---------------- ---------------- ----------------
|M|M|M|M|M|M|M|M| |M|M|M|M|M|M|M|M| |M|M|M|M|M|M|M|M| |M|M|M|M|M|M|M|M|
---------------- ---------------- ---------------- ----------------
      byte 3           byte 2           byte 1           byte 0
Where:
S: sign bit where 1 is negative and 0 is positive
E: exponent with an offset of 1023
M: 53-bit mantissa (stored in 52 bits)
The mantissa is a 53-bit value whose most significant bit (MSB) is always
1 and is, therefore, not stored.
```